REMARKS

Claims 1-11 are pending in this application. By this Amendment, the specification is amended. Reconsideration based on the above amendments and following remarks is respectfully requested.

I. Claim for Priority

The Claim for Priority was included in the Declaration/Power of Attorney which was filed on February 27, 2002. Certified copies of the priority document have been filed in the International Bureau (PCT Rule 17.2(a)) and should be received in national stage application. It is respectfully requested that the Examiner acknowledge Applicants' claim for priority and receipt of the priority document.

II. The Abstract Satisfies All Formal Requirements

The Office Action objects to the Abstract. Specifically, the Office Action asserts that the Abstract contains informalities. The Abstract is amended to obviate the objection. Withdrawal of the objection to the Abstract is respectfully requested.

III. The Claims Define Allowable Subject Matter

The Office Action rejects claims 1-11 under 35 U.S.C. §103(a) as unpatentable over U.S. Patent No. 6,135,100 to Katoh (hereinafter "Katoh") in view of U.S. Patent No. 4,572,136 to Takeuchi et al. (hereinafter "Takeuchi"). This rejection is respectfully traversed.

Katoh does not disclose a device for measuring a quantity of fuel injected by an injector including a pressure sensor respectively measuring the pressure in the first measuring chamber; downstream of the first chamber, a second measuring chamber which is connected to the first measuring chamber by drain pipe and the volume of which can vary according to the movement of a piston, the displacement of which is measured using a displacement sensor; and means of draining the first chamber into the second chamber, as recited in claim 1.

Further, Katoh does not disclose a method of measuring characteristics of an injection of fuel performed by an injector including measuring the pressure and temperature in the first chamber prior to the injection; during injection, measuring, at least regularly, the pressure and temperature in the first chamber; at the end of injection, draining some of the fuel contained in the first chamber into the second chamber so the pressure in the first chamber returns roughly to the pre-injection pressure; and measuring the volume of the drain fuel and from it deducing the volume of the injection, as recited in claim 9.

Instead, Katoh discloses a control system for an internal combustion engine including a sensor 351 constructed in a way so as to protect the exhaust sensing element 108, and which has a construction similar to that in Fig. 7. See Figs. 33-37 and col. 18, lines 6-7. The protective device includes a first accumulator chamber 354 and an accumulator chamber 364. See Figs. 36 et seq. and 54 et seq.; col. 18, lines 6-46; and col. 22, lines 27-52. Therefore, the chambers 354, 364 are related to gas exhaust, not the fuel injection system.

The Office Action appears to assert that fuel injector 45 relates to the sensor 351 including chambers 354, 364 which apply to exhaust. Although Katoh discloses a fuel injector 45, the phrase "a first chamber 354 into which fuel is injected vial fuel injectors 45," as recited on page 8 of the Office Action, does not correspond to the disclosure of Katoh because the Office Action appears to confuse injection with exhaust. Thus, Katoh appears to be remote from the technical domain of the present invention, and at most can "suggest" only partial features of the present invention.

Most conventional injection pumps and many measuring flowmeters, particularly those used for measuring small quantities of injected fuel, use sliding pistons associated with sensors measuring their displacement. Measurements based on variable-volume chambers (piston) do measure volumes, but injection times and durations are measured poorly because of measurement errors due to inertia and mechanical friction.

Likewise, other conventional measuring flowmeters use the measurement of a pressure change in a constant-volume chamber. On the other hand, the constant-volume systems (pressure) do measure times and durations because of the absence of mechanical movements, but these systems measure volumes poorly because of the non-linearity and great variability, particularly temperature-wise, of the law connecting the variation in pressure to the variation in quantity of fluid in the chamber.

The present invention claims the "pipeline" combination (i.e., successively, the first chamber discharges into the second) of these two measurement methods. The present invention includes for each injection, an instantaneous measurement of pressure in the first chamber then a measurement of volume in the second chamber, on the same quantity of injected fluid. The present invention is thus clearly distinguished from systems that operate on averages, combining several successive injections. The present invention includes an instantaneous measurement system for individually measuring two successive injections even if they are widely different from each other, as is the case with sudden changes in speed and load, in automobile engines for example. Systems that average several successive injections are incapable of making this type of measurement.

The present invention also continuously corrects the measurement results of the first chamber by the results of the second chamber, and vice versa. This point is fundamental because the present invention remedies the respective drawbacks of the conventional systems discussed above, using their inherent properties.

The Office Action admits that Katoh does not disclose a displacement sensor of which measures the displacement of piston. However, the Office Action asserts that these deficiencies are made up by Takeuchi. However, Takeuchi does not make up for the deficiencies of Katoh as discussed above. That is, Takeuchi does not disclose the features asserted by the Office Action.

Instead, Takeuchi discloses a fuel injection apparatus including an accumulation housing 26 having the interior of the accumulation housing 26 separated into an accumulation chamber 30 and an atmospherically open chamber 31. See col. 3, line 67 - col. 4, line 7.

The Office Action asserts that Takeuchi discloses a fuel injecting device comprising a first chamber 30 and a second chamber 31, as recited on page 3 of the Office Action. Although the first chamber 30 is a true accumulation chamber filled with fuel, the second chamber 31 communicates with the atmosphere. Therefore, second chamber 31 is an air-filled chamber serving only as a collector for any fuel leaks. See col. 4, lines 17-28. Takeuchi does not provide two measurement chambers both filled with fuel in the normal operation of the device. Thus, Takeuchi discloses only to a partial aspect of the present invention, namely the use of a piston associated with a displacement sensor.

For at least these reasons, it is respectfully submitted that claims 1 and 9 are distinguishable over the applied art. Claims 2-8 and 10-11, which depend from claims 1 and 9, are likewise distinguishable over the applied art for at least the reasons discussed as well as for the additional features they recite. Withdraw of the rejection under 35 U.S.C. §103(a) is respectfully requested.

IV. Conclusion

In view of the foregoing amendments and remarks, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 1-11 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned representative at the telephone number set forth below.

Respectfully submitted,

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WPB:HNS/al

Attachments:
Petition for Extension of Time
Substitute Abstract

Date: July 31, 2003

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ABSTRACT OF THE DISCLOSURE

The measuring device ~~comprises~~ includes a first measuring chamber (8) into which fuel is injected, pressure sensor (62) and a temperature sensor (60) respectively measuring pressure and temperature in the first measuring chamber (8), ~~means~~ devices enabling the measuring chamber to be at least partially drained, an electronic section controlling the system and ~~analysing~~ analyzing information received from the sensors (46, 60, 62). The device also ~~comprises~~ includes a second measuring chamber (20) arranged downstream from the first measuring chamber (8). Fuel which is drained from the first measuring chamber (8) is sent to said second chamber. The volume of the second measuring chamber (20) can vary according to the displacement of a piston (38). ~~Said~~ The displacement is measured with the aid of a displacement sensor (46).